

NON-PUBLIC?: N  
ACCESSION #: 9105300346  
LICENSEE EVENT REPORT (LER)

FACILITY NAME: DIABLO CANYON UNIT 1 PAGE: 1 OF 6

DOCKET NUMBER: 05000275

TITLE: HIGH STEAM GENERATOR LEVEL (P-14) TURBINE TRIP CAUSES  
REACTOR  
TRIP DUE TO FEEDWATER PUMP SPEED CONTROLLER COMPONENT  
FAILURE  
EVENT DATE: 04/23/91 LER #: 91-007-00 REPORT DATE: 05/21/91

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 050

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR  
SECTION:  
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:  
NAME: M. T. Hug, Senior Regulatory TELEPHONE: (805) 545-4859  
Compliance Engineer

COMPONENT FAILURE DESCRIPTION:  
CAUSE: X SYSTEM: SJ COMPONENT: SM MANUFACTURER: L253  
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On April 23, 1991, at 0846 PDT, with Unit 1 in Mode 1 (Power Operation) at approximately 50 percent power, the unit experienced a reactor trip due to a turbine trip caused by high steam generator (SG) 1-3 level (P-14).

Preceding the trip, all main feedwater (MFW) control components were in automatic except SG 1-3 feedwater regulating valve (FCV-530) which was in manual control mode with feedwater regulating bypass valve (FCV-1530) in automatic control mode. At 0834 PDT, MFW pump 1-1 speed had increased by approximately 1000 rpm, initiating a feedwater control transient.

On April 23, 1991, at 0849 PDT, following the turbine trip and reactor

trip, plant operators manually closed the main steam isolation valves to terminate an unanticipated cooldown. At 0903 PDT, the unit was stabilized in Mode 3 at normal reactor coolant temperature and pressure. The 4-hour non-emergency report required by 10 CFR 50.72(b)(2)(ii) was made at 1015 PDT.

The root cause of the initiating feedwater transient was determined to be a random component failure of an operational amplifier in the MFW pump 1-1 speed controller "track and hold" board. The component was replaced and the plant was returned to operation. No corrective actions to prevent recurrence are required. As a prudent action, an operations incident summary will be prepared for review by all plant operators to aid in identifying and responding to abnormal feedwater control occurrences.

5367S/0085K

END OF ABSTRACT

TEXT PAGE 2 OF 6

## I. Plant Conditions

Unit 1 was in Mode 1 (Power Operation) at 100 percent reactor thermal power (RTP). All main feedwater (MFW)(SJ) control components were in automatic except steam generator (SG) 1-3 feedwater regulating valve (FCV-530)(SJ)(FCV), which was in manual control mode with feedwater regulating bypass valve (FCV-1530)(SJ)(FCV) in automatic control mode. All other SG feedwater regulating bypass valves were manually closed.

## II. Description of Event

### A. Event:

On April 23, 1991, at 0834 PDT, a "MFW Pp 1-1 Oil Filter dP High" alarm was received in the control room. Three additional alarms were received: 1) "Digital Feedwater (DFW) Control System Trouble," 2) "MFW Pump 1-1 Thrust Bearing Wear," and 3) "MFW Pump 1-1 Bearing Temperature," as MFW pump 1-1 (SJ)(P) rapidly increased speed by approximately 1000 rpm. Plant operators immediately initiated a turbine load runback, placed MFW pump 1-2 in manual, and raised pump speed by approximately 150 rpm in anticipation of a MFW pump 1-1 trip.

At 0838 PDT, the "Digital Feedwater Control System (DFWCS)

Fails to Manual" alarm was received due to exceeding the feedwater flow overrange setpoint for SG 1-3. The DFWCS (JB)(XC) failed FCV-1530 to the manual mode of operation as designed due to: 1) MFW regulating valve FCV-530 being in manual, 2) increasing feedwater supply pressure resulting from the fixed feedwater pump speeds, and 3) decreasing feedwater demand as the plant load was decreased.

At 0839 PDT, MFW pump 1-1 tripped due to high MFW header pressure. Plant operators restarted MFW pump 1-1 and increased speed to approximately 4000 rpm from the startup station. At 0841 PDT, MFW pump 1-1 tripped again. The MFW pump turbine (SJ)(P)(TRB) was immediately restarted again and the pump speed was increased to approximately 3500 rpm.

At 0846 PDT, level in SG 1-3 exceeded the high level (P-14) setpoint on two out of three of the SG level protection channels. The Solid State Protection System (SSPS) initiated a trip signal for both MFW pump turbines, the main turbine (TA), and all MFW regulating and bypass valves, as designed. Due to RTP being above the reactor trip on turbine trip permissive (P-9) setpoint, the SSPS initiated a reactor trip at approximately 50 percent RTP, as designed. Following the trip, both motor-driven auxiliary feedwater (AFW) pumps (BA) (MO) (P) started due to the trip of both MFW pumps, a "Pressurizer Low Pressure" alarm was received, and a "Low Tavg"

5367S/0085K

TEXT PAGE 3 OF 6

alarm condition was received initiating a main feedwater isolation valve closure signal from the SSPS.

At 0847 PDT, a "Lo-Lo Tavg" alarm was received. Plant operators identified that the plant cooldown rate was greater than normal. At 0848 PDT, a "Pressurizer Low Pressure" alarm was received. At 0849 PDT, turbine-driven AFW pump 1-1 (BA)(TRB)(P) auto-started on low steam generator level, further contributing to the cooldown. Plant operators manually closed the main steam isolation valves (MSIVs) (SB)(ISV) to terminate the plant cooldown. At 0850 PDT, plant operators shut down turbine-driven AFW pump 1-1 to reduce total AFW flow to the steam generators.

At 0858 PDT, the "Lo-Lo Tavg" alarm cleared as the plant heated up following the isolation of the main steam lines. At 0903 PDT, plant operators shut down reactor coolant pumps 1-1 and 1-3 to minimize heat input into the primary system as the primary system was stabilized in Mode 3 (Hot Standby) at normal operating temperature and pressure.

On April 23, 1991, at 1015 PDT, the 4-hour non-emergency report required by 10 CFR 50.72(b)(2)(ii) was made to the NRC Operations Center.

**B. Inoperable Structures, Components, or Systems that Contributed to the Event:**

MFW regulating flow control valve (FCV-530) was maintained in the manual mode of control due to valve position oscillations experienced at full power conditions.

**C. Dates and Approximate Times for Major Occurrences.**

1. April 23, 1991, at 0834 PDT: MFW pump 1-1 alarms received due to rapid speed increase.
2. April 23, 1991, at 0838 PDT: MFW regulating bypass valve fails to manual and MFW pump 1-1 trips twice.
3. April 23, 1991, at 0846 PDT: Event date, Unit 1 reactor trip from turbine trip.
4. April 23, 1991, at 0849 PDT: Operator action is taken to terminate cooldown.
5. April 23, 1991, at 0903 PDT: Unit 1 is stabilized in Mode 3.

5367S/0085K

TEXT PAGE 4 OF 6

6. April 23, 1991, at 1015 PDT: The 4-hour non-emergency report required by 10 CFR 50.72(b)(2)(ii) was made.

**D. Other Systems or Secondary Functions Affected:**

Steam dump valve PCV-2 (SB) (V) was found with the valve stem separated from the plug inner shaft. The results of further investigation and final resolution of this problem will be reported in a supplement to LER 1-90-017, "Reactor Trip Resulting From Failed Pressurizer Spray Valve."

#### E. Method of Discovery:

The event was immediately known to plant operators due to alarms received in the control room.

#### F. Operators Actions:

Plant operators stabilized the plant in Mode 3 in accordance with plant procedures.

#### G. Safety System Responses:

1. The main turbine tripped, both MFW pumps tripped, and all MFW regulating and bypass valves closed on receipt of the P-14 signal.
2. The reactor trip breakers (AA)(BKR) opened
3. The control rod drive mechanism (AA)(DRIV) allowed the control rods to drop into the core.
4. The motor-driven AFW pumps and the turbine-driven AFW pump started as designed.
5. The MSIVs were manually closed.

### III. Cause of the Event

#### A. Immediate Cause:

A component failure (operational amplifier U1) on the "track and hold" circuit board of the Lovejoy MFW pump 1-1 control system (JK)(SM) caused the pump speed to increase until "low selected" at the preset (6100 RPM) level of the manual start-up station. This sudden speed increase initiated a MFW transient which resulted in a high steam generator level P-14 actuation, causing a turbine trip and reactor trip.

5367S/0085K

B. Root Cause:

The root cause of this event has been determined to be a single random failure of an operational amplifier (U1) on the MFW pump speed control system "track and hold" board.

C. Contributory Cause:

MFW regulating valve FCV-530 was in manual during this event and therefore was unable to respond as required resulting in SG 1-3 high feedwater flow (flow transmitter overrange) failure to manual mode of control for the DFWCS. This high feedwater flow to SG 1-3 resulted in SG level oscillations that made it difficult for plant operators to maintain steam generator level.

IV. Analysis of the Event

The initiation of a turbine trip (and resultant reactor trip) due to high steam generator level is a Condition II fault previously evaluated in FSAR Update Chapter 15.2.10, "Excessive Heat Removal Due to Feedwater System Malfunctions." The FSAR Update evaluates common feedwater control system malfunctions such as feedwater valve control malfunction or valve failure and concludes that "the DNBRs encountered for excessive feedwater addition at power are well above the safety analysis limit DNBR values."

This event is bounded by the FSAR Update Chapter 15 analysis. Therefore, the health and safety of the public were not adversely affected, and there were no adverse consequences or safety implications resulting from this event.

V. Corrective Actions

A. Immediate Corrective Actions:

1. MFW pump 1-1 control "track and hold" board was repaired and functionally tested.
2. MFW regulating valve FCV-530 positioner was repaired and functionally tested.
3. PCV-2 was repaired and all steam dump valves were functionally tested.

B. Corrective Actions to Prevent Recurrence:

No corrective actions to prevent recurrence are required based upon a review of the failure history of the operational amplifier component at DCPD and throughout the industry. The component failure was entered into maintenance history for further trending.

5367S/0085K

TEXT PAGE 6 OF 6

As a prudent action, an "Operations Incident Summary" will be prepared for review by all plant operators and operations training personnel to aid in identifying and responding to abnormal feedwater control occurrences.

VI. Additional Information

A. Failed Components:

Operational amplifier U1 on the Lovejoy feedwater pump control "track and hold" board.

B. Previous LERs on Similar Events:

There have been no significant incidents reported at DCPD or to the NPRDS regarding component failures or reactor trips caused by the MFW pump speed control "track and hold" board component (operational amplifier - U1).

5367S/0085K

ATTACHMENT 1 TO 9105300346 PAGE 1 OF 1

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James D. Shiffer  
Senior Vice President and  
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May 21, 1991

PG&E Letter No. DCL-91-135

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D.C. 20555

Re: Docket No. 50-275, OL-DPR-80  
Diablo Canyon Unit 1  
Licensee Event Report 1-91-007-00  
High Steam Generator Level (P-14) Turbine Trip Causes Reactor Trip  
Due to Feedwater Pump Speed Controller Component Failure

Gentlemen:

Pursuant to 10 CFR 50.73(a)(2)(iv), PG&E is submitting the enclosed Licensee Event Report (LER) concerning a high steam generator level turbine trip which caused a reactor trip due to a feedwater pump speed controller component failure.

This event has in no way affected the health and safety of the public.

Sincerely,

J. D. Shiffer

cc: Ann P. Hodgdon  
John B. Martin  
Phillip J. Morrill  
Paul P. Narbut  
Harry Rood  
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Diablo Distribution

DC1-91-TI-N045

Enclosure

5367S/0085K/JHA/2246

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